

CLAIMS

1. A fuel cell humidification apparatus for a fuel cell (1), said fuel cell (1) having oxygen and hydrogen electrodes between which is interposed a solid polymer electrolyte for producing an electromotive force between said electrodes by supplying hydrogen containing reformed gas reformed in reformation means (4) and oxygen containing gas to said hydrogen electrode and to said oxygen electrode, respectively, said fuel cell humidification apparatus comprising humidification means (31) wherein water vapor contained in exhaust gas expelled from said fuel cell (1) penetrates through a water vapor permeable membrane (34) and then supplied, at least, to supply gas to said reformation means (4).
2. The fuel cell humidification apparatus of claim 1, wherein said reformation means (4) includes a partial oxidation reformation section (6) which generates, from source gas, hydrogen rich reformed gas through reactions including partial oxidation.
3. The fuel cell humidification apparatus of claim 2, wherein said humidification means (31) is arranged so that water vapor contained in hydrogen electrode exhaust gas expelled from said hydrogen electrode of said fuel cell (1) penetrates through said water vapor permeable membrane (34) and then supplied either to air or to a mixture of air and

source gas that is introduced into said partial oxidation reformation section (6).

4. The fuel cell humidification apparatus of claim 1, wherein said reformation means (4) includes a water vapor reformation section (43) which generates, from source gas, hydrogen rich reformed gas through reactions.

5. The fuel cell humidification apparatus of claim 4, wherein said humidification means (31) is arranged so that water vapor contained in hydrogen electrode exhaust gas expelled from said hydrogen electrode of said fuel cell (1) penetrates through said water vapor permeable membrane (34) and then supplied to source gas that is introduced into said water vapor reformation section (43).

6. The fuel cell humidification apparatus of claim 3 or claim 5, wherein said humidification means (31) includes a first humidification section (32) which humidifies air or gas with water vapor in hydrogen electrode exhaust gas and a second humidification section (36) which humidifies said air or gas humidified in said first humidification section (32) with water vapor resulting from permeation of heated hot water through a water vapor permeable membrane (38).

7. The fuel cell humidification apparatus of any one of claims 2 through 6, wherein said humidification means (31) is arranged so that water vapor contained in oxygen electrode exhaust gas expelled from said oxygen electrode of said fuel

cell (1) penetrates through said water vapor permeable membrane (34) and then supplied to oxygen containing gas to said fuel cell (1).

8. The fuel cell humidification apparatus of claim 7,
5 wherein said humidification means (31) includes a first humidification section (33) which humidifies gas with water vapor in oxygen electrode exhaust gas and a second humidification section (37) which humidifies said gas humidified in said first humidification section (33) with
10 water vapor resulting from permeation of heated hot water through said water vapor permeable membrane (38).

9. The fuel cell humidification apparatus of claim 2,
wherein said humidification means (31) is arranged so that water vapor contained in oxygen electrode exhaust gas
15 expelled from said oxygen electrode of said fuel cell (1) penetrates through said water vapor permeable membrane (34) and then supplied either to air or to a mixture of air and source gas that is introduced into said partial oxidation reformation section (6).

20 10. The fuel cell humidification apparatus of claim 4,
wherein said humidification means (31) is arranged so that water vapor contained in oxygen electrode exhaust gas expelled from said oxygen electrode of said fuel cell (1) penetrates through said water vapor permeable membrane (34)

and then supplied to source gas that is introduced into said water vapor reformation section (43).

11. The fuel cell humidification apparatus of claim 9 or claim 10, wherein said humidification means (31) includes a first humidification section (33) which humidifies air or gas with water vapor in oxygen electrode exhaust gas and a second humidification section (37) which humidifies said air or gas humidified in said first humidification section (33) with water vapor resulting from permeation of heated hot water through said water vapor permeable membrane (38).

12. The fuel cell humidification apparatus of any one of claims 9 through 11, wherein said humidification means (31) is arranged so that water vapor contained in hydrogen electrode exhaust gas expelled from said hydrogen electrode of said fuel cell (1) penetrates through said water vapor permeable membrane (34) and then supplied to oxygen containing gas to said fuel cell (1).

13. The fuel cell humidification apparatus of claim 12, wherein said humidification means (31) includes a first humidification section (32) which humidifies gas with water vapor in hydrogen electrode exhaust gas and a second humidification section (36) which humidifies said gas humidified in said first humidification section (32) with water vapor resulting from permeation of heated hot water through said water vapor permeable membrane (38).

14. The fuel cell humidification apparatus of claim 3, 5, 7, 9, 10 or 12, wherein said humidification means (31) is formed integrally with said fuel cell (1).

15. The fuel cell humidification apparatus of claim 6, 8, 11, or 13,

wherein said first and second humidification sections (32), (33), (36) and (37) of said humidification means (31) are formed integrally with said fuel cell (1); and

wherein said heated hot water is cooling water for said fuel cell (1).

16. The fuel cell humidification apparatus of 6, 8, 11, or 13,

wherein said first and second humidification sections (32), (33), (36) and (37) of said humidification means (31) are provided separately from said fuel cell (1); and

wherein said heated hot water is hot water for hot water supply means (16).

17. The fuel cell humidification apparatus of any one of claims 1 through 16, wherein said water vapor permeable membrane (34), through which water vapor contained in exhaust gas penetrates, is a hydrophilic membrane.

18. The fuel cell humidification apparatus of any one of claims 1 through 16, wherein said water vapor permeable membrane (34), through which water vapor contained in exhaust

gas penetrates, is a polymer membrane having a sulfonic acid group.

19. The fuel cell humidification apparatus of claim 6, 8, 11, 13, 15 or 16, wherein said water vapor permeable membrane (38) of each of said second humidification sections (36) and (37) is a hydrophobic porous membrane.

20. The fuel cell humidification apparatus of claim 6, 8, 11, 13, 15 or 16, wherein said water vapor permeable membrane (38) of each of said humidification sections (36) and (37) is a porous membrane formed from a porous membrane of the polytetrafluoropolyethylene family, the polypropylene family, or the polyethylene family.